Coil Products

Factory Packaged Controls

Dual Digital Module Technical Guide

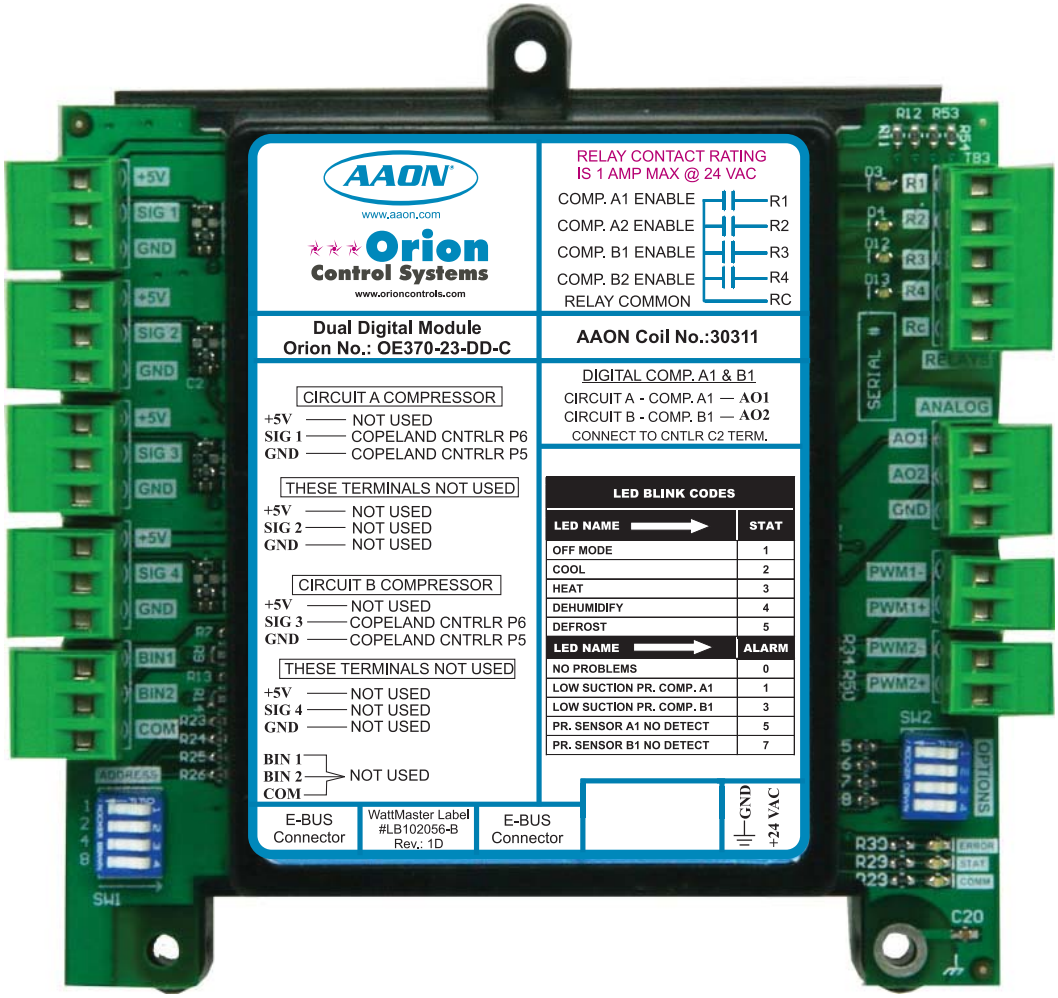

Table of Contents

OVERVIEW 3
Overview 3

INSTALLATION AND WIRING 4
Environmental Requirements 4
Mounting 4
Power Supply and Communications 4
Important Wiring Considerations 5
VCM-S Modular Controller to Dual Digital Module Wiring 6
VCM-X Modular E-BUS Controller to Dual Digital Module Wiring 8

START-UP AND COMMISSIONING 10
General 10
Unit Configurations 10

SEQUENCE OF OPERATION 11
Off Mode 11
Cooling Mode 11
Dehumidification Mode 11
Heat Pump Heating Mode (Air to Air) 11
Defrost Mode 11
Staging Delays 11

TROUBLESHOOTING 12
Using LEDs to Verify Operation 12
LED Diagnostics 13
Other Checks 13

PART NUMBER CROSS REFERENCE TABLE		
PART DESCRIPTION	ORION	AAON COIL
VCM-X Dual Digital Module	OE370-23-DD-C	30311
VCM-X Modular Controller	OE332-23-VCMX-MOD-C	30553
VCM-X Modular E-BUS Controller	OE332-23E-VCMX-C	TBA
VCM-X E-BUS Distribution Module	OE365-23-EBD-C	30312
VCM-X Expansion Module	OE333-23-EM	30308
VCM-X 12 Relay Expansion Module	OE358-23-12R	30309

www.aaon.com

WattMaster Controls Inc.
8500 NW River Park Drive · Parkville , MO 64152
Toll Free Phone: 866-918-1100
PH: (816) 505-1100 · FAX: (816) 505-1101 · E-mail: mail@wattmaster.com
Visit our web site at www.orioncontrols.com

WattMaster Form : AA-DDM-TGD-01F

Copyright December 2013 WattMaster Controls, Inc.

AAON® is a registered trademark of AAON, Inc., Tulsa, OK.
Neither WattMaster Controls, Inc. nor AAON®
assumes any responsibility for errors or omissions in this document.
This document is subject to change without notice.

Overview

The Dual Digital Module (OE370-23-DD-C) is a device that enables and modulates two digital compressors on HVAC Units controlled by the VCM-X Modular Controller (OE332-23-VCMX-MOD-C) or VCM-X Modular E-BUS Controller (OE332-23E-VCMX-MOD-C). The Dual Digital Module will control the digital compressors to satisfy the cooling, dehumidification, and heat pump requirements of the VCM-X Modular series controller.

If the Dual Digital Module is in the Cooling Mode or Heat Pump Heating Mode, it will modulate the compressors to maintain the appropriate Supply Air Temperature Setpoint. If the module is in the Dehumidification Mode, it will modulate compressors to maintain the Coil Suction Temperature Setpoint. If the module is in the Heat Pump Heating Mode, the module can also monitor a signal for a Defrost Cycle from the VCM-X Modular series controller if a Two Condenser Head Pressure Module (OE370-23-HP2C) is also installed.

The Dual Digital Module must be used in conjunction with the VCM-X Modular Controller. The Dual Digital Module is connected to the VCM-X Modular Controller using the E-BUS Distribution Module (OE365-23-EBD). The Dual Digital Module can also be directly connected to the the VCM-X Modular E-BUS Controller. Either connection allows the Dual Digital Module to receive setpoints and monitor the Supply Air Temperature from the VCM-X Modular series controller. The Dual Digital Module requires a 24 VAC power connection with an appropriate VA rating.

NOTE: The Dual Digital Module contains no user-serviceable parts. Contact qualified technical personnel if your module is not operating correctly.

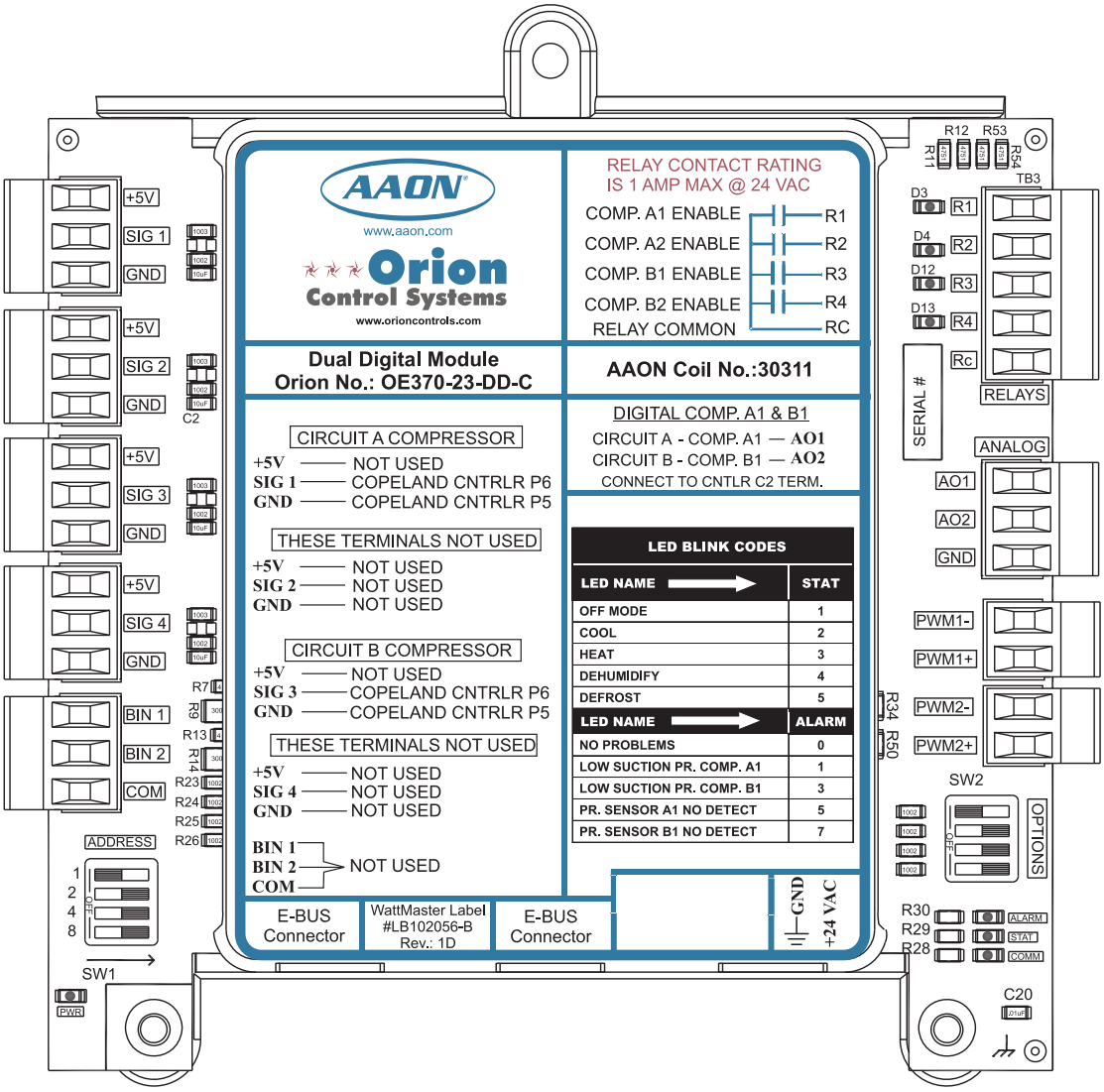

Figure 1: Dual Digital Module

Environmental Requirements

The Dual Digital Module needs to be installed in an environment which can maintain a temperature range between -30°F and 150°F and not exceed 90% RH levels (Non-Condensing).

Mounting

The Dual Digital Module is housed in a plastic enclosure. It is designed to be mounted by using the 3 mounting holes in the enclosure base. It is important to mount the module in a location that is free from extreme high or low temperatures, moisture, dust, and dirt. Be careful not to damage the electronic components when mounting the module.

See Figure 2 for Module dimensions (dimensions are in inches).

Power Supply and Communications

The Dual Digital Module is connected to the E-BUS Distribution Module with a modular HSSC cable to provide communications from the VCM-X Modular Controller. The E-BUS Distribution Module uses WattMaster Control's standard I²C modular cable to connect with the VCM-X Modular Controller, VCM-X Expansion Module, or 12-Relay Expansion Module.

The Dual Digital Module can also be directly connected to the VCM-X Modular E-BUS Controller, bypassing the use of the E-BUS Distribution Module.

The Dual Digital Module requires a 24 VAC power connection with an appropriate VA rating.

WARNING: Observe polarity! All boards must be wired GND-to-GND and 24 VAC-to-VAC. Failure to observe polarity could result in damage to the boards.

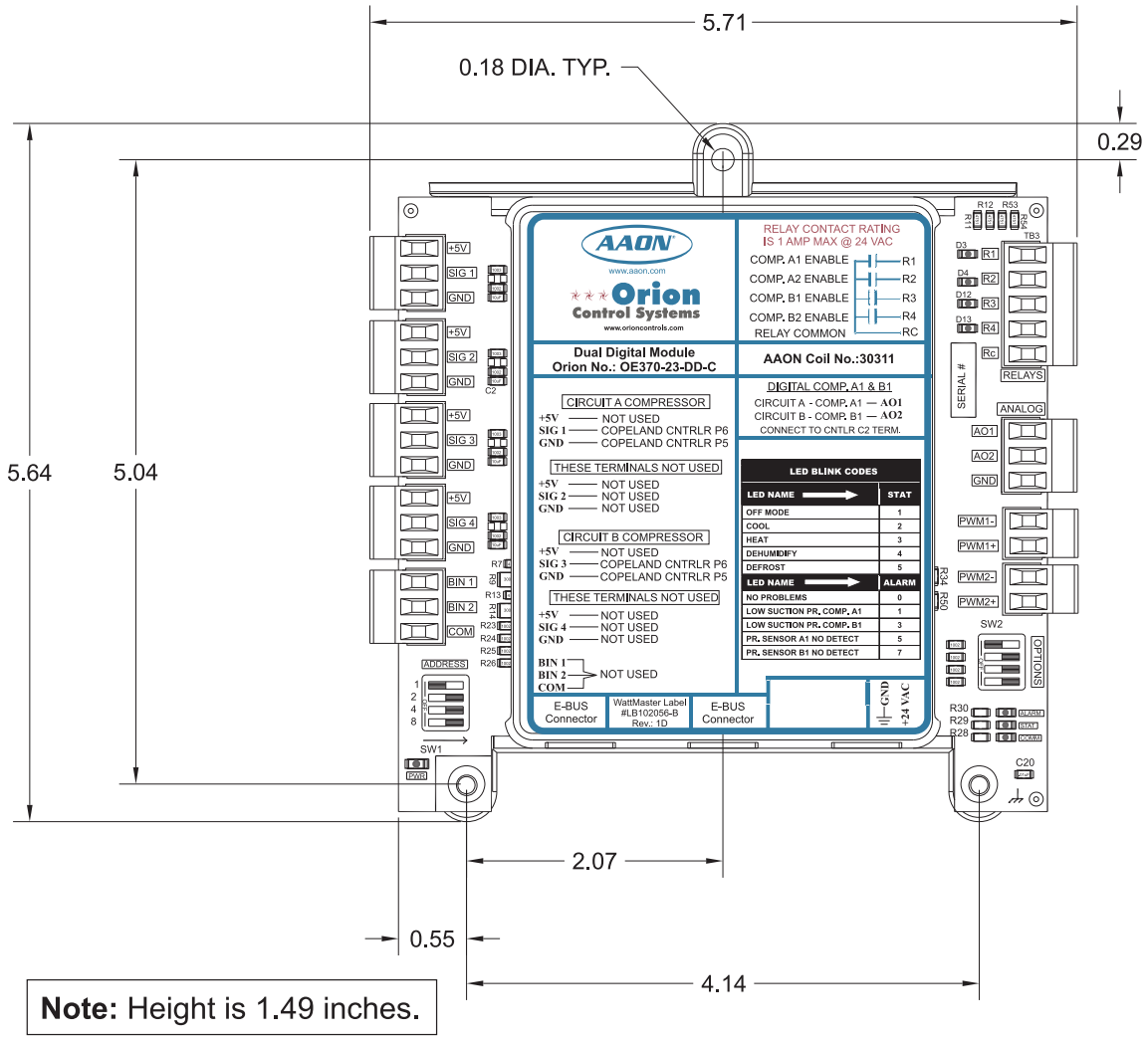

Figure 2: Dual Digital Module Dimensions

Important Wiring Considerations

Please carefully read and apply the following information when wiring the Dual Digital Module:

1. The 1 to 5 VDC signals for the Copeland Compressor Speed need to use 18-gauge shielded twisted pair cable, and the Drain wire must be the GND signal.
2. All 24 VAC wiring must be connected so that all ground wires remain common. Failure to follow this procedure can result in damage to the module and connected devices.
3. All wiring is to be in accordance with local and national electrical codes and specifications.
4. Be sure that all wiring connections are properly inserted and tightened into the terminal blocks. Do not allow wire strands to stick out and touch adjoining terminals. This could potentially cause a short circuit.
5. Be sure all modular wiring harness connectors are seated firmly in their respective modular connectors on the circuit board.

NOTE: The Compressor Relays on the Dual Digital Module are used rather than the relay outputs on the VCM-X Modular series controller.

WARNING: Be sure all controllers and modules are powered down before connecting or disconnecting HSSC cables.

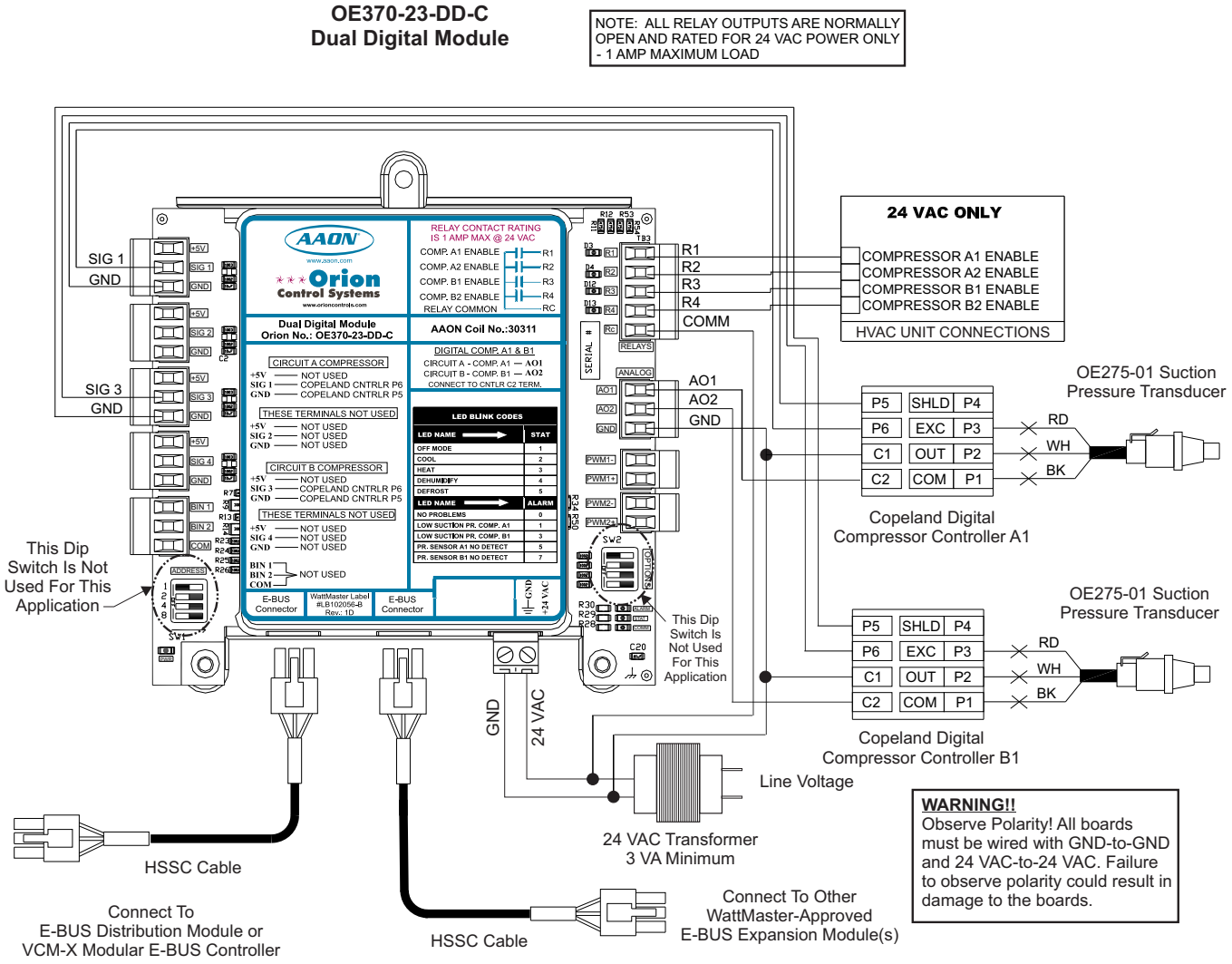

Figure 3: Dual Digital E-BUS Connection Wiring

VCM-X Modular Controller to Dual Digital Module Wiring

When using the VCM-X Modular Controller, the E-BUS Distribution Module is required ot connect to the Dual Digital Module. The Dual Digital Module connects to the E-BUS Distribution Module using a modular HSSC cable. The Dual Digital Module requires a 24 VAC power connection with an appropriate VA rating.

The E-BUS Distribution Module connects to the VCM-X Modular Controller, VCM-X Expansion Module, or 12 Relay Expansion Module using the I²C port. See **Figure 4** below for wiring.

Any E-BUS module can be connected to each of the four E-BUS Distribution Module's output ports or can be daisy-chained together using HSSC cables.

If using a spliced terminal connection for longer runs, one module can be connected to the E-BUS Distribution Module and any additional modules would be daisy-chained to the first module. For more information, refer to the *E-BUS Distribution Module Technical Guide.*

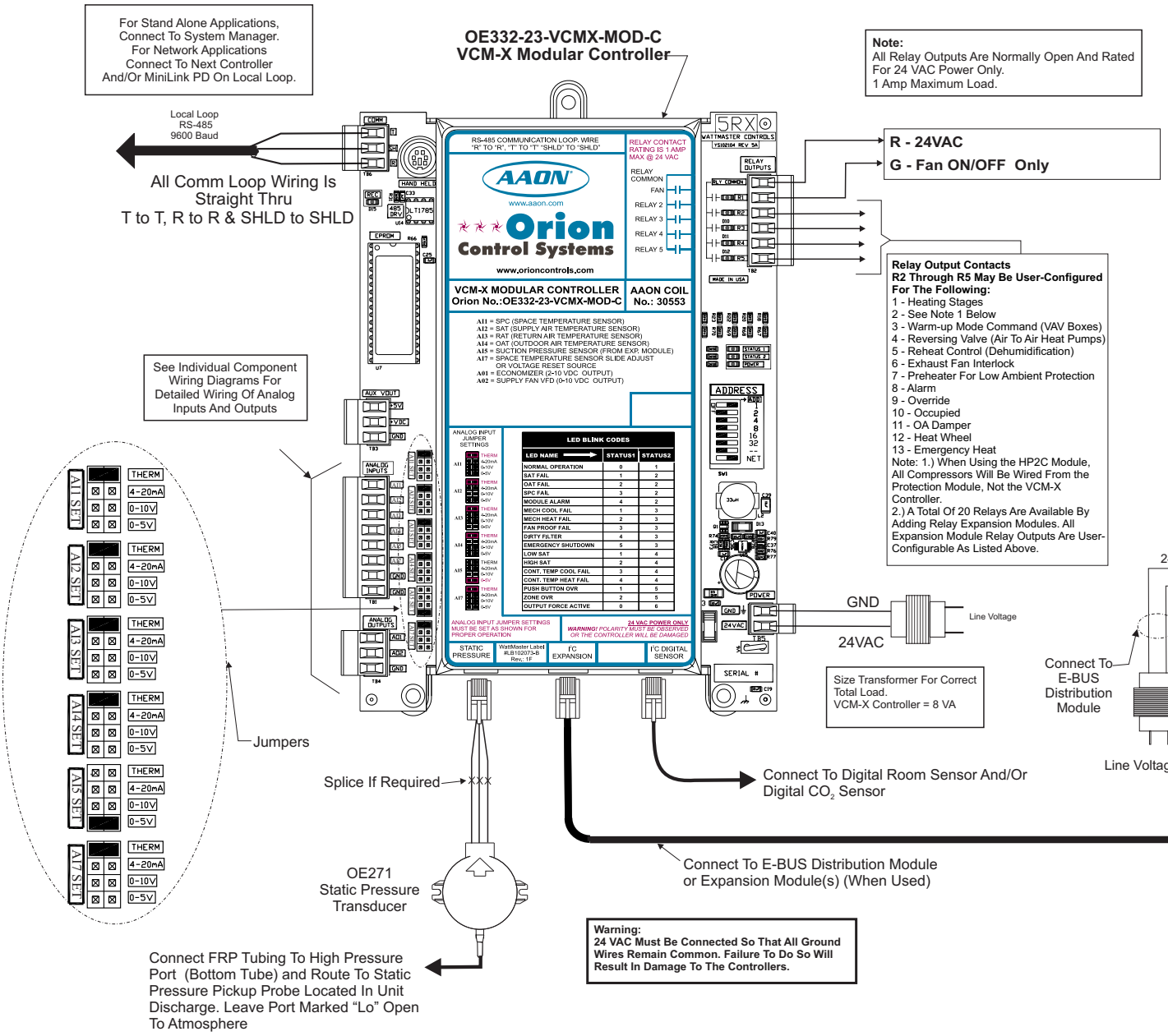
For Stand Alone Applications, Connect To System Manager. For Network Applications Connect To Next Controller And/Or MiniLink PD On Local Loop.
OE332-23-VCMX-MOD-C
VCM-X Modular Controller
Note:
All Relay Outputs Are Normally Open And Rated For 24 VAC Power Only.
1 Amp Maximum Load.
Local Loop
RS-485
9600 Baud
All Comm Loop Wiring Is Straight Thru
T to T, R to R & SHLD to SHLD
R - 24VAC
G - Fan ON/OFF Only
Relay Output Contacts
R2 Through R5 May Be User-Configured For The Following:
1 - Heating Stages
2 - See Note 1 Below
3 - Warm-up Mode Command (VAV Boxes)
4 - Reversing Valve (Air To Air Heat Pumps)
5 - Reheat Control (Dehumidification)
6 - Exhaust Fan Interlock
7 - Preheater For Low Ambient Protection
8 - Alarm
9 - Override
10 - Occupied
11 - OA Damper
12 - Heat Wheel
13 - Emergency Heat
Note: 1.) When Using the HP2C Module, All Compressors Will Be Wired From the Protection Module, Not the VCM-X Controller.
2.) A Total Of 20 Relays Are Available By Adding Relay Expansion Modules. All Expansion Module Relay Outputs Are User-Configurable As Listed Above.
See Individual Component Wiring Diagrams For Detailed Wiring Of Analog Inputs And Outputs
AAON
www.aaon.com
Orion Control Systems
www.orioncontrols.com
VCM-X MODULAR CONTROLLER
Orion No.:OE332-23-VCMX-MOD-C
AAON COIL
No.: 30553
LED BLINK CODES
GND
24VAC
Line Voltage
Size Transformer For Correct Total Load.
VCM-X Controller = 8 VA
24 VAC
GND
Connect To E-BUS Distribution Module
Line Voltage
Jumpers
Splice If Required
Connect To Digital Room Sensor And/Or Digital CO2 Sensor
Connect To E-BUS Distribution Module or Expansion Module(s) (When Used)
OE271
Static Pressure
Transducer
Connect FRP Tubing To High Pressure Port (Bottom Tube) and Route To Static Pressure Pickup Probe Located In Unit Discharge. Leave Port Marked "Lo" Open To Atmosphere
Warning:
24 VAC Must Be Connected So That All Ground Wires Remain Common. Failure To Do So Will Result In Damage To The Controllers.

Figure 4: VCM-X Modular Controller Connection to Dual Digital Module

NOTE: Contact Factory for the correct HSSC cable length for your application. Cables are available in ¼, ½, 1, 2, 3, 4, and 5 Meter lengths and 100 and 150 Foot lengths.

WARNING: Be sure all controllers and modules are powered down before connecting or disconnecting HSSC cables.

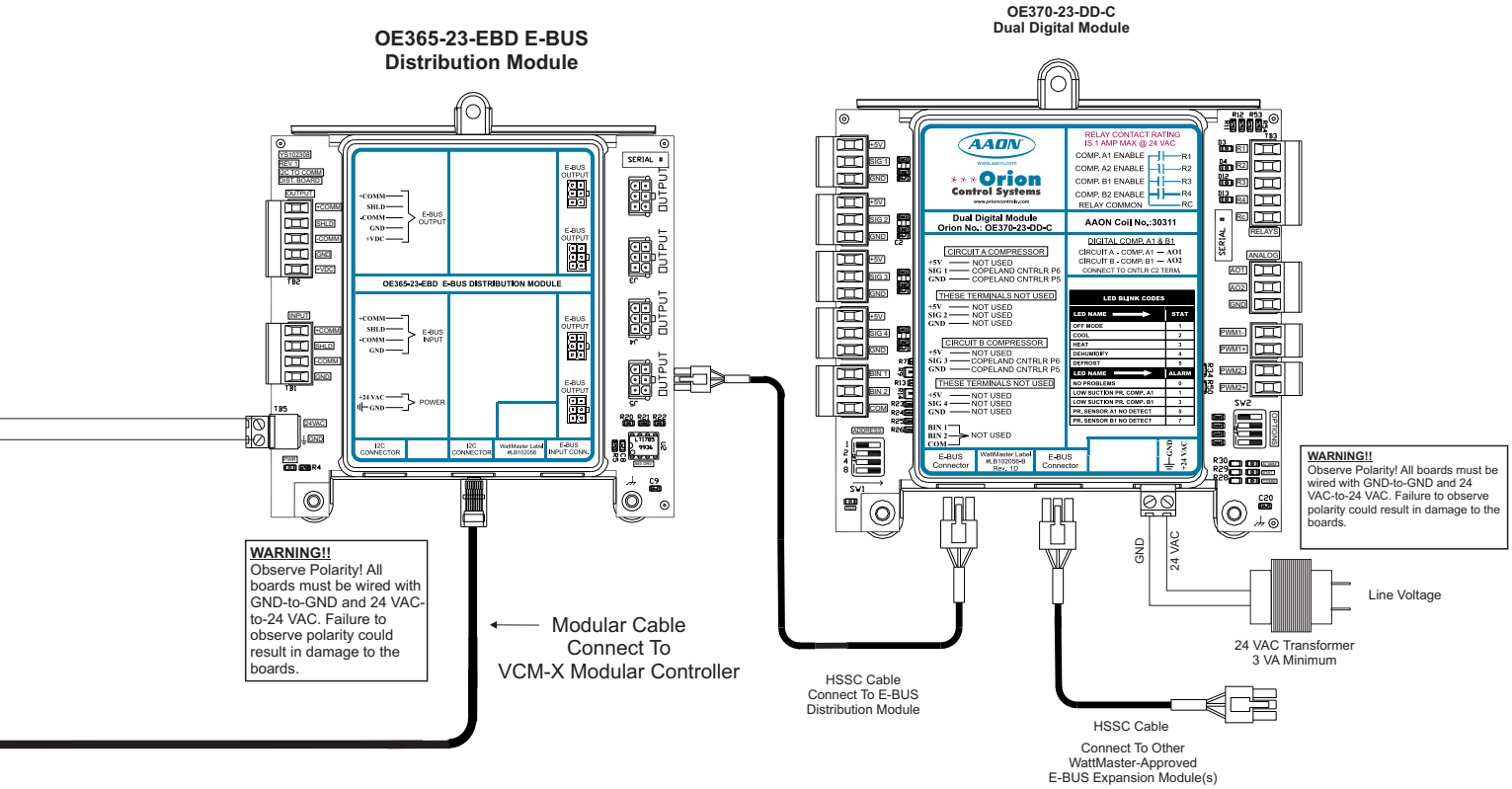
OE365-23-EBD E-BUS
Distribution Module
OE370-23-DD-C
Dual Digital Module
WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24 VAC-to-24 VAC. Failure to observe polarity could result in damage to the boards.
Modular Cable
Connect To
VCM-X Modular Controller
HSSC Cable
Connect To E-BUS
Distribution Module
HSSC Cable
Connect To Other
WattMaster-Approved
E-BUS Expansion Module(s)
GND
24 VAC
Line Voltage
24 VAC Transformer
3 VA Minimum
WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24 VAC-to-24 VAC. Failure to observe polarity could result in damage to the boards.

Figure 4: VCM-X Modular Controller Connection to Dual Digital Module

E-BUS Controller to Dual Digital Module Wiring

VCM-X Modular E-BUS Controller to Dual Digital Module Wiring

The Dual Digital Module directly connects to the VCM-X Modular E-BUS Controller using a modular HSSC cable. The Dual Digital Module requires a 24 VAC power connection with an appropriate VA rating. See **Figure 5** below for wiring.

Any E-BUS Module can be connected to the E-BUS Controller's E-BUS port or can be daisy-chained together using HSSC cables.

NOTE: Contact Factory for the correct HSSC cable length for your application. Cables are available in ¼, ½, 1, 2, 3, 4, and 5 Meter lengths and 100 and 150 Foot lengths.

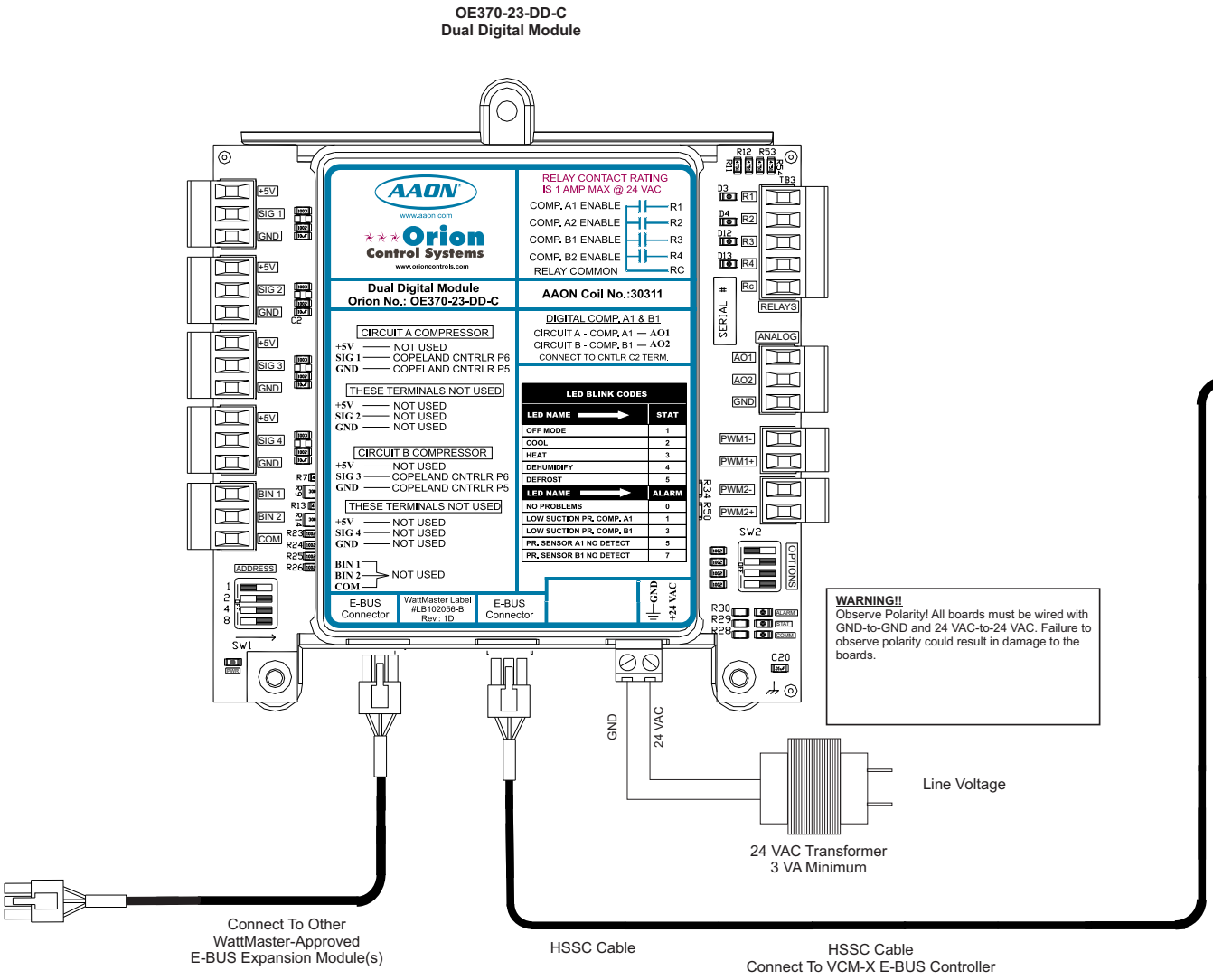

Figure 5: VCM-X Modular E-BUS Controller to Dual Digital Module Wiring Diagram

E-BUS Controller to Dual Digital Module Wiring

WARNING: Be sure all controllers and modules are powered down before connecting or disconnecting HSSC cables.

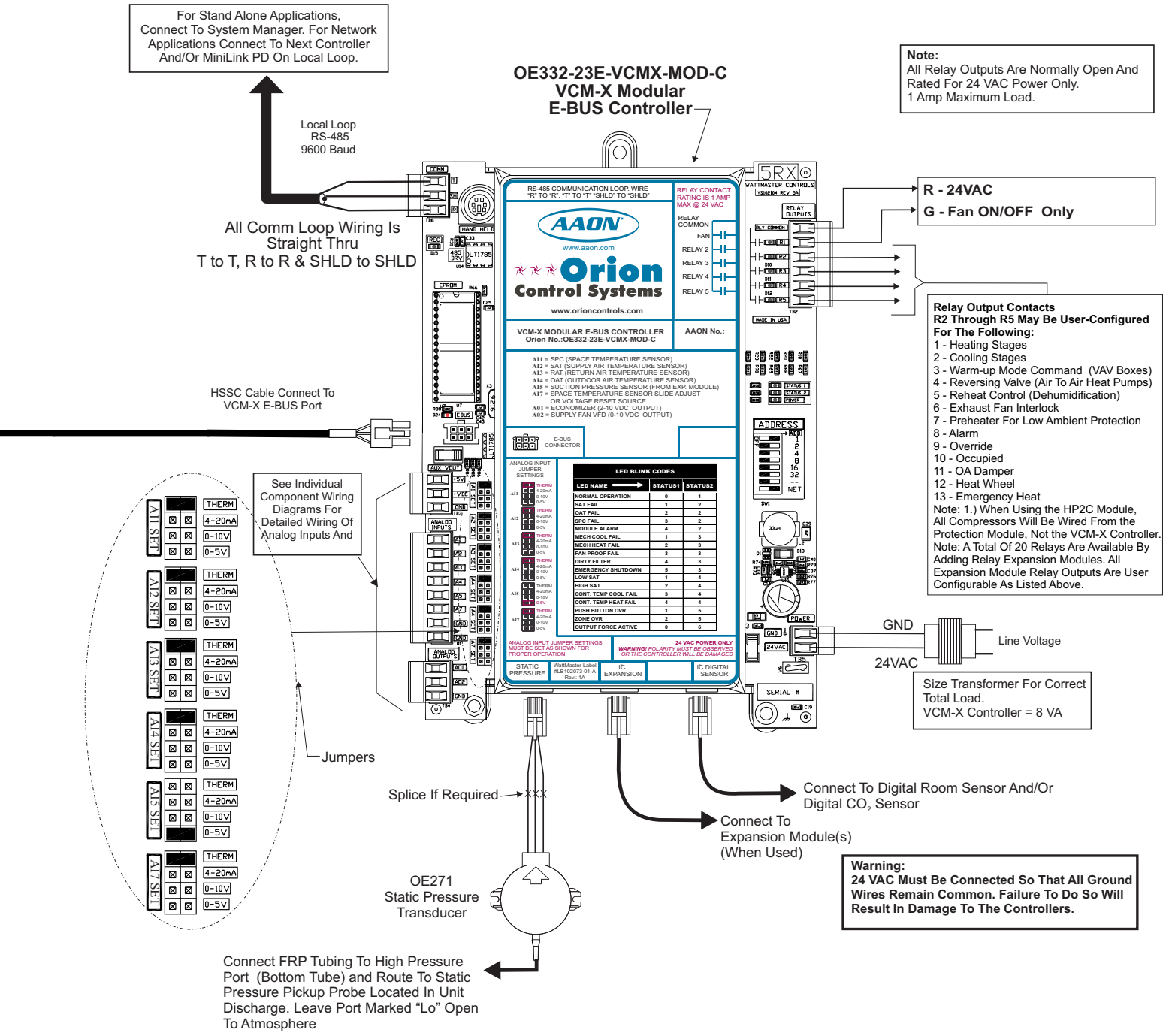
For Stand Alone Applications, Connect To System Manager. For Network Applications Connect To Next Controller And/Or MiniLink PD On Local Loop.
Local Loop RS-485 9600 Baud
All Comm Loop Wiring Is Straight Thru T to T, R to R & SHLD to SHLD
OE332-23E-VCMX-MOD-C VCM-X Modular E-BUS Controller
Note: All Relay Outputs Are Normally Open And Rated For 24 VAC Power Only. 1 Amp Maximum Load.
R - 24VAC
G - Fan ON/OFF Only
Relay Output Contacts R2 Through R5 May Be User-Configured For The Following:
1 - Heating Stages
2 - Cooling Stages
3 - Warm-up Mode Command (VAV Boxes)
4 - Reversing Valve (Air To Air Heat Pumps)
5 - Reheat Control (Dehumidification)
6 - Exhaust Fan Interlock
7 - Preheater For Low Ambient Protection
8 - Alarm
9 - Override
10 - Occupied
11 - OA Damper
12 - Heat Wheel
13 - Emergency Heat
Note: 1.) When Using the HP2C Module, All Compressors Will Be Wired From the Protection Module, Not the VCM-X Controller. Note: A Total Of 20 Relays Are Available By Adding Relay Expansion Modules. All Expansion Module Relay Outputs Are User Configurable As Listed Above.
HSSC Cable Connect To VCM-X E-BUS Port
See Individual Component Wiring Diagrams For Detailed Wiring Of Analog Inputs And
Jumpers
GND
24VAC
Line Voltage
Size Transformer For Correct Total Load. VCM-X Controller = 8 VA
Splice If Required
Connect To Digital Room Sensor And/Or Digital CO2 Sensor
Connect To Expansion Module(s) (When Used)
OE271 Static Pressure Transducer
Connect FRP Tubing To High Pressure Port (Bottom Tube) and Route To Static Pressure Pickup Probe Located In Unit Discharge. Leave Port Marked "Lo" Open To Atmosphere
Warning: 24 VAC Must Be Connected So That All Ground Wires Remain Common. Failure To Do So Will Result In Damage To The Controllers.
AAON
www.aaon.com
Orion Control Systems
www.orioncontrols.com
VCM-X MODULAR E-BUS CONTROLLER Orion No.:OE332-23E-VCMX-MOD-C
AAON No.:
RELAY CONTACT RATING IS 1 AMP MAX @ 24 VAC
RELAY COMMON
FAN
RELAY 2
RELAY 3
RELAY 4
RELAY 5
LED BLINK CODES
LED NAME
STATUS1
STATUS2
NORMAL OPERATION
SAT FAIL
OAT FAIL
SPC FAIL
MODULE ALARM
MECH COOL FAIL
MECH HEAT FAIL
FAN PROOF FAIL
DIRTY FILTER
EMERGENCY SHUTDOWN
LOW SAT
HIGH SAT
CONT. TEMP COOL FAIL
CONT. TEMP HEAT FAIL
PUSH BUTTON OVR
ZONE OVR
OUTPUT FORCE ACTIVE
ANALOG INPUT JUMPER SETTINGS MUST BE SET AS SHOWN FOR PROPER OPERATION
24 VAC POWER ONLY
WARNING! POLARITY MUST BE OBSERVED OR THE CONTROLLER WILL BE DAMAGED
STATIC PRESSURE
I2C EXPANSION
I2C DIGITAL SENSOR
A11 SET
A12 SET
A13 SET
A14 SET
A15 SET
A17 SET
THERM
4-20mA
0-10V
0-5V

Figure 5, cont.: VCM-X E-BUS Controller to Dual Digital Module Wiring Diagram

Start Up and Commissioning

General

In order to have a trouble free start-up, it is important to follow a few simple procedures. Before applying power for the first time, it is very important to run through a few simple checks.

One of the most important checks to make before powering up the system for the first time is to make sure that the VCM-X Modular or VCM-X Modular E-BUS Controller is configured properly for your application. Refer to the *VCM-X Controller Technical Guide* or *VCM-X Modular E-BUS Controller Technical Guide* for more information.

A handheld Modular Service Tool, Modular System Manager, or System Manager Touch Screen connected to the VCM-X Modular or VCM-X Modular E-BUS Controller will allow you to configure your application. Refer to the *VCM-X Operator's Interfaces Technical Guide* or *System Manager TS Technical Guide* for more information.

Check all wiring leads at the terminal block for tightness. Be sure that wire strands do not stick out and touch adjacent terminals. Confirm that all sensors required for your system are mounted in the appropriate location and wired into the correct terminals.

WARNING: Observe polarity! All boards must be wired GND-to-GND and 24 VAC-to-VAC. Failure to observe polarity could result in damage to the boards.

UNIT CONFIGURATIONS						
PERMUTATION	CIRCUIT A		CIRCUIT B		HARDWARE	VCM-X WSHP CONFIGURATION
	Comp A1	Comp A2	Comp B1	Comp B2		
	Relay 1	Relay 2	Relay 3	Relay 4		
1	Fixed	N/A	Fixed	N/A	Use VCM-X Modular Series Controller Only	2 Compressors
2	Digital	N/A	Fixed	N/A	Use VCM-X Modular Series Controller Only	2 Compressors Digital Compressor
3	Digital	N/A	Digital	N/A	Use VCM-X Modular Series Controller and Dual Digital Module	2 Compressors Dual Digital
4	Fixed	Fixed	Fixed	Fixed	Use VCM-X Modular Series Controller Only	4 Compressors
5	Digital	Fixed	Fixed	Fixed	Use VCM-X Modular Series Controller Only	4 Compressors Digital Compressor
6	Digital	Fixed	Digital	Fixed	Use VCM-X Modular Series Controller and Dual Digital Module	4 Compressors Dual Digital

Table 1: Unit Configurations Chart

NOTE: See Unit Configurations Chart on page 10 for more information about compressor staging.

Off Mode

The Dual Digital Module will be in the Off Mode when no signal is being received from the VCM-X Modular series controller to run the compressors.

Cooling Mode

When a Cool Signal is received, the Dual Digital Module will go into Cooling Mode. At this point, Compressor A1 will energize and modulate as necessary to maintain the Supply Air Temperature at the Active Supply Air Setpoint that is broadcast from the VCM-X Modular series controller.

When Compressor A1 reaches 100%, a stage up timer is started. If Compressor A1 stays at 100% for the stage up timer, Compressor B1 will energize and both compressors will go to 50% and begin to modulate together.

If there are additional fixed compressor stages and modulating Compressors A1 and B1 have modulated together up to 100%, then after a stage up delay, fixed Compressor A2 will stage on while A1/B1 go to 50% and begin to modulate from there. If A1/B1 again modulate up to 100%, then after a stage up delay, fixed compressor B2 will stage on while A1/B1 go to 50% and begin to modulate from there.

Staging down will happen in the reverse order as just described if the Supply Air Temperature falls below the Supply Air Temperature Setpoint by the Cooling Stage Window value and the stage down timer has elapsed. After the fixed compressors have staged off, or if there are no fixed compressors, then the staging down of the digital compressors A1 and B1 will continue as follows. If Compressors A1/B1 modulate together down to 30% and the stage down timer elapses, Compressor B1 will deactivate and Compressors A1 will go to 60%. Compressors A1 will stage down if it is at 0% for the duration of the stage down timer.

Heat Pump Heating Mode (Air to Air)

Heating Mode works the same as Cooling Mode except the Reversing Valve is switched and the sequence is opposite. Compressors modulate up when below the Heating Supply Air Setpoint and modulate down when above the setpoint.

Dehumidification Mode

In Dehumidification Mode, the compressor(s) will modulate to maintain the Suction Pressure Temperature Setpoint broadcast from the VCM-X Modular series controller. If there are two compressors, Compressor A1 will modulate up to 100% before Compressor B1 can be energized. If Compressor B1 is energized, Compressor A1 will be locked at 100%.

If there are additional fixed compressor stages and Compressor B1 has modulated up to 100%, then after a stage up delay, fixed Compressor A2 will stage on while B1 will again go to 50% and begin to modulate from there. If B1 again modulates up to 100%, then after a stage up delay, fixed compressor B2 will stage on while B1 will again go to 50% and begin to modulate from there.

Stage down will again be the reverse as just described with Compressor A1 being the last compressor to stage off.

Defrost Mode

In Defrost Mode, if only Circuit A is energized, it will go to 100% and the reversing valve will deactivate. If both Circuit A & Circuit B are energized, they will both go to 100% and the reversing valve will be deactivated. The duration for Defrost Mode is determined by the VCM-X Modular series controller.

NOTE: Defrost Mode is only available if a Two Condenser Head Pressure Module is installed.

Staging Delays

Staging Delays minimum run times and minimum off times are sent from the VCM-X Modular series controller.

Using LEDs to Verify Operation

The Dual Digital Module is equipped with LEDs that can be used to verify operation and perform troubleshooting. There are LEDs for communication, operation modes, and diagnostic codes. The module has seven LEDs—one used for power, one used for operation status, one used for alarms, and four used for the compressor relays. See **Figure 6** for the LED locations. The LEDs associated with these inputs and outputs allow you to see what is active without using a voltmeter. The LEDs and their uses are as follows:

① Status LEDs

"COMM" - The COMM LED lights up to indicate Communications between the module and the VCM-X Modular series controller. If Communications are established, the COMM LED will blink.

"ALARM" - This is the diagnostic blink code LED. It will light up and blink out diagnostic codes. See **Table 2** for Diagnostic Blink Code descriptions. The blink code descriptions are also located on the module's front cover.

No. of Blinks	Status
0	No Problems
1	Low Suction Pressure Compressor A1
3	Low Suction Pressure Compressor B1
5	Pressure Sensor A1 Not Detected
7	Pressure Sensor B1 Not Detected
9	No Communication

Table 2: ALARM LED Blink Codes

"STAT" - This is the status blink code LED. It will light up and every 10 seconds will blink the status mode that the module is currently operating under. See **Table 3** for Status Blink Code code descriptions. The blink code descriptions are also located on the module's front cover.

No. of Blinks	Status
1	Off Mode
2	Cool Mode
3	Heat Mode
4	Dehumidify Mode
5	Defrost Mode

Table 3: STAT LED Blink Codes

② Compressor LEDs

"R1" - This LED will light up when Compressor A1 is enabled and will stay lit as long as Compressor A1 is active.

"R2" - This LED will light up when Compressor A2 is enabled and will stay lit as long as Compressor A2 is active.

"R3" - This LED will light up when Compressor B1 is enabled and will stay lit as long as Compressor B1 is active.

"R4" - This LED will light up when Compressor B2 is enabled and will stay lit as long as Compressor B2 is active.

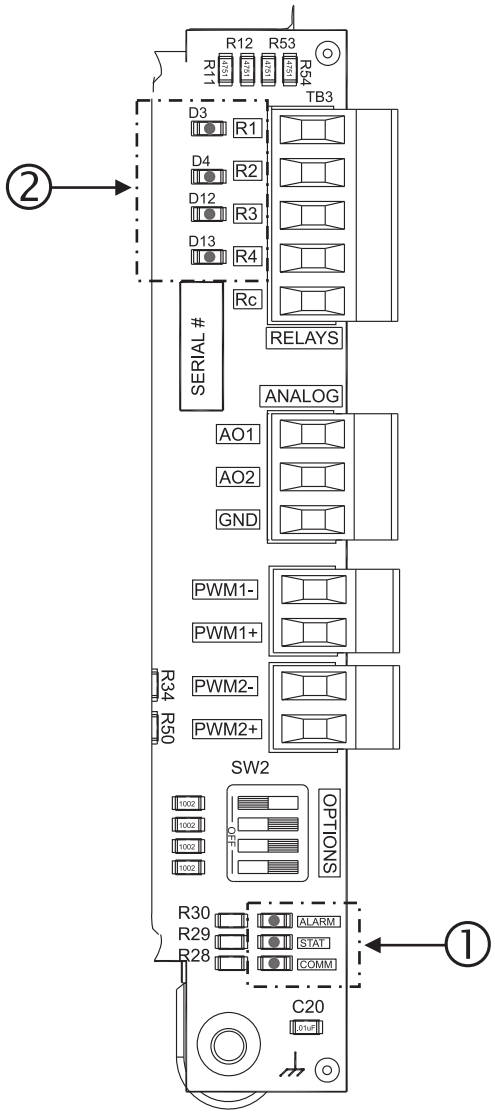

Figure 6: LED Locations

LED Diagnostics

"PWR" LED: When the Dual Digital Module is powered up, the PWR LED (located below the address switches) should light up and stay on continuously. If it does not light up, check to be sure that the power wiring is connected to the board, the connections are tight, and the VCM-X Modular series controller is powered. If after making all these checks, the PWR LED does not light up, the module is probably defective.

"COMM" LED: The COMM LED lights up to indicate Communications between the module and the VCM-X Modular series controller. If the COMM LED does not blink, then communications have not been established. Check the connection between the VCM-X Modular Controller, the VCM-X Modular E-BUS Controller, the E-BUS Distribution Module, and the Dual Digital Module.

"STAT" LED: As previously described, this LED will blink out the operation mode that the Dual Digital Module is operating under. When the board is first powered up, the STAT LED will do the following:

- Light up
- Blink out status code every ten seconds to indicate controller status

"ALARM" LED: As previously described, this LED will blink on and off to indicate alarms and diagnostics.

Other Checks

NOTE: The Dual Digital Module contains no user-serviceable parts. Contact qualified technical personnel if your module is not operating correctly.

OE275-01 Suction Pressure Transducer Testing for R410A Refrigerant

The Evaporator Coil Temperature is calculated by converting the Suction Pressure to Temperature. The Suction Pressure is obtained by using the OE275-01 Suction Pressure Transducer, which is connected into the Suction Line of the Compressor.

Use the voltage column to check the Suction Pressure Transducer while connected to the Dual Digital Module. Read voltage with a meter set on DC volts. If the temperature/voltage or pressure/voltage readings do not align closely with the chart, your Suction Pressure Transducer is probably defective and will need to be replaced.

See the OE275-01 Suction Pressure Transducer, Pressure, Temperature, and Voltage Chart for R410A Refrigerant testing (**Table 4)**. The chart shows a temperature range from 20°F to 80°F. For troubleshooting purposes, the DC Voltage readings are also listed with their corresponding temperatures and pressures.

OE275-01 Suction Pressure Transducer Coil Pressure – Temperature – Voltage Chart for R410A Refrigerant					
Temperature °F	Pressure PSI	Signal DC Volts	Temperature °F	Pressure PSI	Signal DC Volts
21.19	80.94	1.8	59.03	168.10	3.2
24.49	87.16	1.9	61.17	174.32	3.3
27.80	93.39	2.0	63.19	180.55	3.4
30.99	99.62	2.1	65.21	186.78	3.5
33.89	105.84	2.2	67.23	193.00	3.6
36.80	112.07	2.3	69.24	199.23	3.7
39.71	118.29	2.4	71.15	205.46	3.8
42.30	124.52	2.5	72.95	211.68	3.9
44.85	130.75	2.6	74.76	217.91	4.0
47.39	136.97	2.7	76.57	224.14	4.1
49.94	143.2	2.8	78.37	230.36	4.2
52.23	149.42	2.9	80.18	236.59	4.3
54.50	155.65	3.0			
56.76	161.88	3.1			

Table 4: Coil Pressure/Voltage/Temp for OE275-01 Suction Pressure Transducers - R410A Refrigerant

Notes

AAON Coil Products
203 Gum Springs Road • Longview, TX 75602-1721
Ph: (903) 236-4403 • Fax: (903) 236-4463
WattMaster Manual Form No: AA-DDM-TGD-01F